



COLLEGE OF INTENSIVE CARE MEDICINE OF AUSTRALIA AND NEW ZEALAND

EXAM REPORT OCTOBER 2011

This report is prepared to provide candidates, tutors and Supervisors of Training with information regarding the assessment of candidates' performance in the General Fellowship Examination. Answers provided are not necessarily model answers but guides as to what was expected. Candidates should discuss the report with their tutors so that they may prepare appropriately for future examinations.

The exam comprises a written section and an oral section. The written exam consists of two 2.5 hour papers of 15 ten-minute short answer questions each. Candidates are required to score at least 50% in the written section to be eligible to sit the oral section. The oral exam consists of eight interactive vivas and two separate clinical "hot cases".

The tables below provide an overall statistical analysis as well as information regarding performance in the individual sections. A comparison with data from the three previous exams is provided.

Please note images from the SAQs have been removed.

Overall Performance	October 2011	May 2011	October 2010	May 2010
Presenting for written (Including OTS)	55	36	48	43
Carrying a pass from a previous attempt	11	7	8	7
OTS Exempt	0	0	2	2
Total number presenting (written + carry + OTS)	66	43	58	52

Pathway to oral section				
Invited to orals (>50% in written section)**	45	33	30	36
Total number invited to oral section	56	43	39	54

**Please note - One candidate who passed the written section in May 2011 elected to postpone their attempt at the oral section until October 2011.

Analysis of performance in individual sections	October 2011	May 2011	October 2010	May 2010
Successful in the written section	45/55 81%	23/36 64%	33/48 69%	30/43 70%
Successful in the Hot Case section	39/56 69%	15/29 52%	32/43 74%	20/39 51%
Successful in both Hot Cases	22/56 39%	5/29 17%	22/43 51%	13/39 33%
Successful in the viva section	44/56 78%	20/29 69%	40/43 93%	32/39 82%

Sectional pass rates – Hot Cases	October 2011		May 2011	
	Pass rate	Highest individual mark	Pass rate	Highest individual mark
Hot Case 1	59%	90%	45%	83%
Hot Case 2	57%	87%	41%	86%

Sectional pass rates - Vivas	October 2011		May 2011	
	Pass rate	Highest individual mark	Pass rate	Highest individual mark
Viva 1	66%	90%	69%	85%
Viva 2	75%	100%	86%	85%
Viva 3	65%	79%	69%	70%
Viva 4	79%	86%	69%	80%
Viva 5	93%	92%	55%	70%
Viva 6 (X ray)	54%	84%	86%	86%
Viva 7 (Communication)	68%	90%	52%	100%
Viva 8 (Procedure)	86%	90%	27%	90%

Oral section pass rates	October 2011	May 2011	October 2010	May 2010
Candidates who scored >50% in written section and passed the overall exam	36/45 80%	17/22 77%	27/33 82%	24/30 80%
All candidates invited to oral section and passed the overall exam (written + carry + OTS)	43/56 76%	18/29 62%	35/43 81%	27/39 69%
Overall Pass Rate	43/66 65%	18/43 42%	35/58 60%	27/52 52%

EXAMINERS' COMMENTS

Written Paper

- The pass rate was less than 50% for 9 of the 30 questions. Questions with a pass rate less than 33% included those relating to complications of cardiopulmonary bypass, cervical spine clearance in head injury, fluid resuscitation and sepsis and management of raised intracranial pressure and post traumatic seizures.
- As in previous exams, candidates who failed did not answer the questions as asked and/or were too narrow in their answer. It appears that candidates do not always read the questions carefully and thoroughly.
- Candidates who failed the written section passed an average of 14/30 questions compared with candidates scoring > 50% and gaining an invitation to the oral section, passing an average of 21/30 questions.

Hot Cases

The overall pass rate was similar to previous exams. Concerns expressed by the examiners included:

- Slow, hesitant and unsystematic examination of the patient
- Disorganised presentation of the clinical findings
- Lack of a definitive plan for patient management with decision-making at a registrar level rather than senior registrar/junior consultant
- Listing overall goals of management but unable to explain how to achieve them eg “wean the inotropes” in a patient with cardiogenic shock post CABG, with no explanation of how to improve cardiac function
- Inability to synthesise the information available and demonstrate adequate decision-making ability

Candidates are reminded that they should not sit the General Fellowship Examination until they can confidently examine patients, present the clinical findings and discuss management issues at the appropriate level, i.e. senior registrar/junior consultant.

Vivas

The Vivas tend to be the section in which candidates perform well and the pass rate in the Vivas for this exam of 78% reflects this. The Viva with the lowest pass rate (54%) was the radiology station. Failure in the general viva section was related primarily to lack of knowledge, and an inability to answer the question asked. The procedure station this year was a combined equipment/procedure station and candidates were asked to manage a difficult airway. Candidates who failed were unable to demonstrate the use of a laryngeal mask.

GENERAL FELLOWSHIP WRITTEN EXAMINATION

Paper 1

Q1

List the complications and their likely underlying mechanisms specifically related to cardiopulmonary bypass that may be seen in the Intensive Care Unit following cardiac surgery.

Respiratory complications

Left lower lobe collapse (poor re-inflation post bypass, phrenic nerve injury)
Increased pulmonary vascular resistance (protamine)
Acute lung injury (SIRS)

Cardiovascular complications

Myocardial stunning or infarction (inadequate myocardial protection)
Coronary graft ischaemia (air embolism)
Right ventricular dysfunction (pulmonary hypertension related to protamine)
Hypoperfusion and end-organ ischaemia related to non-pulsatile flow and/or air/atheroma embolism

Neurological complications

Cerebrovascular events, watershed infarcts, neurocognitive dysfunction (low flow, thromboembolism)
Phrenic nerve palsy (use of cold cardioplegia 'slush')

Renal complications

Dysfunction related to ischaemia and SIRS

Gastro-intestinal complications

Splanchnic ischaemia (low flow, thromboembolism)
Hepatic dysfunction, acalculous / gangrenous cholecystitis, pancreatitis (hypoperfusion, SIRS)

Haematological complications

Coagulopathy (effects of hypothermia and dilutional coagulopathy, residual heparinisation, activation of coagulation cascade during bypass)
Anaemia (haemodilution, blood loss in the circuit)
Platelet dysfunction (bypass circuit)
Haemolysis (bypass circuit)

Metabolic complications

Hypothermia (intra-operative cooling and delayed re-warming)
Insulin resistance and hyperglycaemia (hypothermia)
Electrolyte abnormalities (haemodilution, post-pump diuresis)

Immune-mediated complications

Activation of coagulation cascade (blood contact with non-biological surfaces and blood-gas interface)
SIRS (leucocyte and complement activation, cytokine release and expression of adhesion molecules stimulated by contact with bypass circuit)
Allergic reactions to protamine

% passed	22%
Highest mark	72%

Q2

Define cachexia. List the factors that may predispose to cachexia AND the consequences of cachexia in a ventilated patient with sepsis and multi-organ dysfunction syndrome.

Define Cachexia

Weight loss and skeletal muscle wasting due to illness where the body does not reduce catabolism (unlike the adaptive reduction in protein metabolism that occurs in starvation)

Predisposing factors

- Mechanisms not clearly understood
- Pre-existing malnutrition / malabsorption.
- Cytokine-induced up-regulation of muscle protein degradation
- Neuro-endocrine – stimulation of hypothalamic-pituitary-adrenal axis
- Reduced circulating anabolic hormones
- Immobility and prolonged length of stay
- Corticosteroid therapy
- Malignancy

Consequences

- Increased risk of death
- Prolonged time on ventilator
- Increased ICU and hospital length of stay
- Increased risk of nosocomial infections
- Poor wound healing
- Malnutrition and nutritional deficiency syndromes

% passed	40%
Highest mark	75%

Q3

3.1 A 70-year-old, 42kg female with chronic renal failure, Type 2 diabetes and a history of alcohol abuse was admitted for management of leg ulcers infected with MSSA. Ten days into her admission she became increasingly short of breath and was referred to ICU.

Parameter	Patient Value	Normal Range
Sodium	139 mmol/l	134 – 146
Potassium	4.4 mmol/l	3.4 – 5.0
Chloride	115* mmol/l	100 – 110
Urea	15.3* mmol/l	3.0 – 8.0
Creatinine	309* μ mol/l	50 – 120
Glucose	5.1 mmol/l	3.0 – 5.4
pH	7.11*	7.35 – 7.45
PCO ₂	13* mmHg (1.7* kPa)	35 – 45 (4.6 – 6.0)
HCO ₃	4* mmol/l	22 – 27
Base excess	-24*	-2 – +2
Measured osmolality	300 mOsm/kg	280 – 300

a) Describe this acid-base picture

Severe compensated metabolic acidosis with a raised anion gap (≈ 20), normal osmolar gap and Δ ratio 0.4 (Some candidates might say that there is both a high AG and normal AG acidosis rather than stating the delta ratio and that is also correct).

b) Give three possible causes

Renal failure
 Pyroglutamic acidosis (renal and liver dysfunction and possible flucloxacillin and paracetamol exposure)
 Sepsis
 Metformin related lactic acidosis
 (Δ ratio suggests mixed AG and NAG MA or renal failure)

3.2 These results are from the arterial blood gas report of a 41-year-old female ventilated in ICU for three weeks with H1N1 influenza and ARDS

Parameter	Patient Value	Normal Range
FiO ₂	0.6	
pH	7.5*	7.35 – 7.45
pO ₂	79.0 mmHg (10.5 kPa)	
pCO ₂	48.0* mmHg (6.3 kPa)	35 – 45 (4.6 – 6.0)
HCO ₃	36* mmol/L	22 – 27
Base excess	12*	-2.0 – +2.0
Sodium	138 mmol/L	135 – 145
Potassium	5.0 mmol/L	3.5 – 5.0
Chloride	97 mmol/L	95 – 105

a) Describe the abnormalities in the blood gas report.

Metabolic alkalosis
 A-a DO₂ 295

b) What is the likely cause of the acid-base disturbance?

Resolution of respiratory acidosis with delayed correction of metabolic compensation
 Diuretic therapy

3.3 A 26-year-old man with a history of solvent abuse presents to the Emergency Department

Parameter	Patient Value	Normal Range
FiO ₂	0.4	
pH	6.94*	7.35 – 7.45
PO ₂	140 mmHg (18.4 kPa)	
PCO ₂	17* mmHg (2.2 kPa)	35 – 45 (4.6 – 6.0)
HCO ₃	4* mmol/L	22 – 27
Base excess	-28*	-2.0 – +2.0
Sodium	127* mmol/L	135 – 145
Chloride	113* mmol/L	95 – 105
Urinary pH	7.2	4.6 – 8.0

a) Describe the acid-base disturbance

Normal anion gap severe metabolic acidosis with incomplete compensation

b) What is the likely cause of the acid-base disturbance?

Renal tubular acidosis Type 1 distal secondary to chronic toluene abuse

% passed	96%
Highest mark	90%

Q4

An 18-year-old male has been involved in a high-speed motor vehicle accident and admitted to your hospital. His initial GCS at the scene was 5 (E2, V2, M1). He has been intubated and has a hard collar in place.

a) What is your approach to the management of the hard collar and justify your practice?

The patient is sedated and so the spine cannot be cleared clinically so will keep collar in place. Also check correct size and fitting.

Firstly clear radiologically – review all images and obtain formal radiologist reports

Trauma series (typically only CXR and pelvic XR as C-spine films are low yield and no longer suggested as a routine) looking for obvious vertebral fractures +/- dislocations as patients with a fracture on CXR or PXR have higher risk of C-spine fracture

High resolution 64 slice helical CT of the entire cervical spine and T1 with sagittal and coronal reconstructions

With technically adequate studies and experienced interpretation, the combination of multi-slice helical CT with reconstruction CT scanning provides a false negative rate of < 0.1%

Clear radiologically and if low risk for ligamentous injury and patient unlikely to be extubated in 24-48 hr, remove collar

Or:

If no bony injury but need to exclude ligamentous injury, perform MRI

Or:

If bony injury present assessment for instability and surgery and immobilization as indicated in discussion with spinal surgeons

b) List the potential problems associated with inability to clear the cervical spine at an early stage?

Prolonged immobilization is associated with significant morbidity

Decubitus ulceration (especially related to cervical collar)

Increased need for sedation

Delayed weaning from respiratory support

Delays in percutaneous tracheostomy

Central venous access difficulties

Enteral feeding intolerance due to supine positioning

Pulmonary aspiration due to supine positioning

DVT due to prolongation of immobility

Increased risk of cross-infection due to extra staff / equipment involved in position changes

% passed	33%
Highest mark	70%

Q5

- 5.1 **A 75-yr-old woman on Indapamide for Hypertension presented with seizures after a 7-day history of increasing lethargy. She was unwell, had dry mucus membranes and decreased skin turgor with a BP 88/50. Her serum sodium was 103 mmol/L.**

Outline your fluid management and discuss relevant physiology.

- This woman requires Hypertonic Saline for her hyponatremic encephalopathy.
- She also requires isotonic fluid therapy (e.g. 0.9 % NaCl) to correct her Hypovolemia

Once volume repletion crosses the hypovolemic threshold for the adaptive excessive ADH release that would have occurred (in part explaining her hyponatremia), there would be a feed-back inhibition of the excess ADH release leading to massive aquaresis and the increased free water excretion would help correct hyponatremia

- 5.2 **By day 5 of her admission, the serum sodium has increased to 141 mmol/L. The anti-hypertensive therapy was adjusted and she was discharged home. Ten days after the initial presentation, she is readmitted with ataxia and confusion. On examination, the following findings were noted:**

Afebrile

GCS E4, M6, V4. No neck stiffness

Tremor++, ataxia ++.

Droling of saliva +

Brisk jaw jerk, bilaterally brisk reflexes, extensor plantar reflexes.

Full blood count: Nil significant

ELFT: normal.

You are called to the ED to assess this patient as there are concerns that she might be an aspiration risk.

- List 2 likely differential diagnoses for her presentation.**

Osmotic demyelination syndrome

Brainstem stroke

- List 4 underlying predisposing conditions**

Alcoholism

Malnutrition

Prolonged diuretic use

Liver failure

Organ transplant

Burns

% passed	76%
Highest mark	80%

Q6

6.1

ECG 1 (image removed)

This is the ECG of a 74-year-old gentleman who had an out of hospital cardiac arrest.

- 1. What are the abnormalities on the ECG**
- 2. What would your management plan be if the patient makes a good functional neurological recovery?**

Answer

1. Right bundle branch block and left posterior fascicular (or right axis deviation) block
2. Permanent Pacemaker + Coronary angiography to exclude coronary vascular disease

6.2

This is the ECG of a 77-year-old woman.

ECG 2 (image removed)

- 1. Describe the ECG.**
- 2. Give two possible reasons for the ST changes.**

Answer

1 Regular rhythm rate 75. atrial pacing spike, t wave flattening with reverse tick

2 Ischaemia or digoxin

6.3

ECG 3 (image removed)

- 1 Describe the ECG shown.**
- 2 Give two interventions that may assist in clarification as to the aetiology of this rhythm?**

Answers

1 Narrow complex tachycardia rate 170-200 bpm. ST depression inferiorly. Meets voltage criteria for Left ventricular hypertrophy with strain. Could be atrial flutter or atrial fibrillation or SVT

2 Either carotid sinus massage (after auscultation of carotids to exclude bruit) or other vagal manoeuvre or administration of push dose of adenosine if no asthma.

6.4

ECG 4 (image removed)

1. Describe the ECG shown.
2. Which coronary artery territory may be involved in the pathophysiology of this case?

Answer

- 1 Sinus rhythm of 92 bpm. ST elevation of >2mm in II, III AVF and V5,6 with reciprocal changes in V1 and AVR. Consistent with myocardial infarction or pericarditis
- 2 Right coronary artery territory or LCx if dominant left system.

% passed	93%
Highest mark	97%

Q7

A previously well 12-day-old term infant is retrieved from a peripheral centre into your emergency department with increasing respiratory distress.

On arrival RR – 70

Sat 89% on nasal cannula at 1L/min

PR – 150

BP – 80/40

- a) **What is the normal range of oxygen saturation, respiratory rate, pulse rate and blood pressure in a healthy term neonate?**

Normal BP for neonate 75/40 mmHg range 60-80 systolic 40-50 diastolic
Normal pulse rate for neonate 100-160, 100 when asleep 160 when crying
Normal RR for Neonate 30-60 – average 40
Saturation >93% on room air

- b) **Excluding tachypnoea, list four (4) commonly seen clinical signs of respiratory distress in a newborn**

1. Distortion of the chest wall (sternal and rib retraction, recession of intercostal, subcostal and suprasternal spaces) *Accept alternative terminology*
2. Pallor
3. Apnoea
4. Bradycardia
5. Lethargy, listlessness, decreased level of consciousness

c) List four (4) most likely causes for this presentation.

Upper airway obstruction
Bronchiolitis
Pneumonia
Aspiration
Cardiac failure (usually associated with high pulmonary blood flow, VSD, PDA, truncus arteriosus etc; left heart obstructive lesions; coarctation of the aorta; aortic stenosis)
Sepsis

d) List four (4) factors that predispose neonates to respiratory failure

- Increased metabolic demand – oxygen consumption twice that of the adult
- Structural immaturity of the thoracic cage – ribs short and horizontal, bucket motion is minimal - infant is dependant on diaphragmatic displacement of abdominal contents to increase volume of the thorax any increase in abdominal distension may compromise respiratory function.
- Infant airways – small and more prone to obstruction
- Immaturity of immune system increasing susceptibility to infection
- Immature development of the respiratory system – particularly in premature infants with surfactant deficiency, alveolar instability, reduced lung compliance
- Immaturity of respiratory control – immature respiratory centre results in inadequate respiratory drive and can lead to apnoea.
- Congenital abnormalities – either respiratory or cardiovascular may lead to early respiratory failure
- Perinatal injuries – pneumothorax, neuromuscular including perinatal asphyxia which can result in apnoeas.

% passed	58%
Highest mark	80%

Q8

An electrical fire breaks out in the equipment room of your fully occupied 15-bed ICU. Outline the principles of management of this emergency.

Remove all patients and staff from immediate danger area with safe disconnection of lines, monitoring and equipment and manual ventilation of patients.

Raise the alarm – notify switchboard, stating exact location and nature of fire and activate fire alarm. Activate unit fire drill and take instructions from the designated area fire warden.

Contain the fire closing all doors and windows. Turn off oxygen outlets.

If fire is smaller than a waste basket attempt to extinguish with appropriate extinguishers (CO₂ and dry powder) and fire blankets if safe to do so

If fire cannot be controlled commence evacuation of patients with most stable first and most unstable last and continuing essential organ support, monitoring and essential medications. Depending on the extent of the fire this may be:

- Horizontal evacuation through at least one set of fire doors to another part of the ICU or an acute care area on the same floor
- Vertical evacuation via stairs to the floor below
- Out of building evacuation

Liaison with ED, OT, HDU, CCU and other high care areas in the hospital and/or neighbouring hospitals for ongoing care of the evacuated patients

Review of incident and response to identify cause of fire and any issues with management with subsequent review of fire policy and implementation of staff education and simulation exercises

% passed	67%
Highest mark	75%

Q9

9.1 The following arterial blood gas and biochemistry results are from a patient with cardiac and respiratory disease and recent profuse vomiting

Parameter	Patient Value	Normal Range
FiO ₂	0.4	
pH	7.5	7.35 – 7.45
PaO ₂	58.0 mmHg (7.6 kPa)	
PaCO ₂	47* mmHg (6.2 kPa)	35 – 45 (4.6 – 6.0)
HCO ₃	34.8* mmol/l	22 – 27
Base Excess	10.2*	-2.0 – +2.0
Sodium	137 mmol/l	135 – 145
Potassium	2.5* mmol/l	3.5 – 5.0
Chloride	92* mmol/l	95 – 105

a) Describe the acid-base disturbance(s)

Metabolic alkalosis with respiratory compensation

b) List the potential causes of the acid-base abnormalities in this patient

Possible causes in this patient:

Diuretic therapy

Steroid therapy

Vomiting from gastric outlet obstruction

Post hypercapnoeic alkalosis

9.2 A 35-year-old woman with pre-eclampsia is admitted to ICU following an emergency Caesarian section under general anaesthesia for failure to progress during labour at 38 weeks gestation. Arterial blood gas, full blood count and electrolytes post extubation are as follows:

Parameter	Patient Value	Normal Range
FiO ₂	0.5	
pH	7.31*	7.35 – 7.45
PaO ₂	150 mmHg (19.7 kPa)	
PaCO ₂	42 mmHg (5.5 kPa)	35 – 45 (4.6 – 6.0)
HCO ₃	20.1* mmol/l	22 – 27
Base excess	-5	-2.0 – +2.0
Sodium	137 mmol/l	135 – 145
Potassium	4.3 mmol/l	3.5 – 5.0
Chloride	106* mmol/l	95 – 105
Haemoglobin	110* g/l	125 – 165
White cell count	19.8* x 10 ⁹ /l	4.0 – 11.0
Neutrophils	17.3* x 10 ⁹ /l	1.8 – 7.5
Lymphocytes	2.5 x 10 ⁹ /l	1.5 – 4.0

a) Describe and explain the acid-base status

Acute respiratory acidosis

At 38 weeks pregnancy the normal PaCO₂ is <30 mmHg with a compensatory reduction in bicarbonate. The blood gases therefore indicate acute CO₂ retention probably due to pain and narcotics. In the non-pregnant patient these results would indicate an uncompensated normal anion gap metabolic acidosis.

b) Calculate and interpret the A-a gradient

A-a gradient – this is raised at 154 mmHg, suggesting shunt and/or V/Q mismatch. Possible explanations are the loss of FRC after abdominal surgery, segmental collapse/consolidation or aspiration

c) What is the likely significance of the anaemia and the leukocytosis?

Hb and WCC – the mild anaemia is physiological in pregnancy and the neutrophil leukocytosis is a normal feature during labour and early post-partum

% passed	85%
Highest mark	85%

Q10

Critically evaluate the use of plasma troponin in the critically ill patient

- Greater specificity to cardiac damage than CK-MB / AST which can also be found in skeletal muscle
- Useful marker in acute coronary syndromes, where a higher level is indicative of a greater mortality and morbidity
- There has been recent discussion regarding the use of troponin and the diagnosis of myocardial infarction, and the definition has been standardised by the ECS / AHA. Myocardial infarction is defined as demonstration of myocardial ischaemia plus the addition of a significant plasma troponin rise (*Circulation 2007*)
- It is not quantitatively validated outside the setting of ACS / AMI, but qualitatively it is associated with a poorer outcome in the critically ill patient
- Numerous studies that show plasma troponin can be raised in other cardiac conditions, e.g. pericarditis, atrial fibrillation cardioversion, and non cardiac conditions e.g. renal failure, PE, sepsis.
- Plasma troponin levels should be used as a **risk stratification tool** in conjunction with other tests e.g. ecg and echo, depending on the presenting medical condition
- This has significance in critically ill patients in the non ACS-AMI setting. Medications used for a troponin rise in the setting of ACS / AMI, e.g. anti-coagulants and anti-platelet therapy are not benign, and can have detrimental effects in critically ill patients who have troponin rises due to non ACS / AMI
- Monitoring for ischaemia in the ICU patient

% passed	44%
Highest mark	66%

Q11

A 45-year-old intellectually handicapped man is admitted to your Intensive Care Unit for airway management. He is currently nasally intubated following an evacuation of a large dental abscess that had caused airway compromise.

Describe how you would assess his readiness for extubation.

Readiness for extubation requires an assessment of factors that necessitated intubation in the first place and standard criteria.

Standard criteria would include:

- Adequacy of oxygenation (usually on $FiO_2 \leq 0.4$ and PEEP 5)
- Ventilation (minimal respiratory support eg low level of PS ≤ 10). Some other ventilatory indices may be used (eg rapid shallow breathing index, negative inspiratory force, $P_{0.1}$, CROP, V_t 4-6 ml/kg, V_{min} 10-15 L/min)
- Protection of airway (adequate cough \pm gag)
- Ability to clear secretions
- Appropriate neurological state (obeys command, orientated)
- Stable haemodynamics not requiring support
- Sepsis controlled
- Metabolic / biochemical parameters normal

Specifics for this man would also include:

- Assessment of airway swelling with direct/indirect visualization
- Discussion with treating surgical team regarding timing and management of ongoing swelling
- Adjust criteria for neurological state given his intellectual handicap

% passed	80%
Highest mark	90%

Q12

An 86-year-old gentleman is admitted to intensive care with acute lung injury causing respiratory failure, secondary to gallstone-induced acute pancreatitis. Evidence in the literature suggests enteral nutrition is appropriate.

a. How would you approach his enteral nutrition after a successful ERCP?

Access: Nasojejunal tube although nasogastric (appears safe and well tolerated)

Any reasonable approach OK

- 1) Determine target rate for enteral nutrition, commencing 30ml/hour and increasing as tolerated and delivered as a continuous infusion to maximise chances of achieving nutritional target rates.
- 2) Prokinetics could be considered if large aspirates are experienced. A feeding protocol should be utilised to maximise the chances of achieving nutritional target rates.
- 3) Nutritional targets in the critically ill can be determined by either indirect calorimetry, predictive equations (eg: Harris-Benedict equation) or simplistic formulae (25-30kcal/kg/day) with at least 1.2-2g/kg/day of protein.
- 4) Avoid probiotics (the only multi-centre RCT showed increased mortality and incidence of MOF in treatment group)

b. List the complications that need to be considered with utilising enteral nutrition?

1) Tube complications

Misplacement: Pneumothorax, inadvertent pulmonary infusion

Sinusitis

Pressure areas on nose/lip

Trauma to nasopharynx, oesophagus, stomach and haemorrhage

2) Feed complications

Inadequate caloric intake from gastric stasis

Diarrhoea

Ventilator associated pneumonia

Electrolyte abnormalities

Hyperglycaemia

c. When might you consider parenteral nutrition?

Despite following a rigorous enteral feeding protocol, there is inadequate caloric intake after five days. Combined enteral and parenteral nutrition to meet targets may be beneficial.

Recent NEJM article June 2011 comparing early (day 2) with late (day 8) TPN in ICU patients not meeting nutritional targets with EN showed better outcomes in late TPN group

% passed	56%
Highest mark	90%

Q13

You are asked to admit a 46-year-old man who has just been intubated in the Emergency Department after collapsing from what appears clinically to be a brain stem stroke. His Glasgow Coma Score prior to intubation was 6.

Outline your management strategy for him for the first 24 hours.

Activate the stroke team if available in this hospital as urgent intervention is needed for the best potential outcome – involves neurologist and interventional neuroradiologist

Attention to ABC (confirm tube position, adequacy of ventilation, control hypertension and treat hypotension to ensure adequate CPP)

Investigations / Interventions

- CT scan to exclude bleed and confirm diagnosis – can miss post fossa and brainstem lesions in the early stages so MRA may be indicated
- Interventional cerebral angiography and thrombectomy if within time window and facilities and resources available.
- Thrombolysis with tPA within 4.5 hours of event if intervention unavailable or unsuccessful
- Heparin infusion
- Aspirin

Physiological monitoring and maintenance of normal parameters (BP, Na, BSL etc)

Role of EVD if hydrocephalus is present

Ongoing neurological assessment – at risk of progressing to locked in syndrome

Supportive care of the intubated ventilated critically ill patient

Discussion with family re therapy and outlook plus risk factors for poor outcome

% passed	56%
Highest mark	87%

Q14

A 44-year-old man with morbid obesity (BMI 68 kg/m²) presents to the Emergency Department with respiratory failure. He is obtunded with an arterial blood gas (ABG) showing pH 7.25, pCO₂ 75 mmHg (10kPa), PO₂ 53 mmHg (7 kPa), HCO₃ 32 mmol/L on FiO₂ 0.3. Chest X-Ray reveals cardiomegaly and clear lung fields.

Describe your management of this problem for the first 24 hours.

Management includes simultaneous resuscitation and assessment with history and examination, investigations, (appropriate and interpreted) and ongoing fluid therapy (including triage, monitoring, pharmacology and non-pharmacological interventions).

ABG information given confirms type 1 and type 2 respiratory failure.

Cardiomegaly may relate to AP portable semi-erect film but cardiomyopathy and ?pericardial effusion should be considered.

Other causes of decreased conscious state in addition to hypercapnia and hypoxia should be considered, such as drug toxicity, metabolic / endocrine / electrolyte disturbances.

Resuscitation consists of ensuring adequate airway, ventilatory support as needed, ensuring adequate circulation and assessment of other, readily reversible causes of decreased conscious state such as opiates, hypoglycaemia.

Airway support may be by simple measures such as positioning and airway adjuncts as needed and conscious level permits (nasopharyngeal airway better tolerated than oropharyngeal).

NIV if maintaining airway and protective reflexes present but invasive ventilation if NIV not appropriate or fails.

Assessment of difficulty of intubation. Invasive ventilation potentially hazardous given morbid obesity.

Appropriate ventilator settings accepting high peak pressures needed to overcome chest wall mass and intra-abdominal pressure (transpulmonary pressure [Palveolar – Pintrapleural pressure] will be normal).

History and examination should suggest/exclude any diagnoses including: ischaemic heart disease, cardiac failure (left and right), COAD, venous thromboembolism, respiratory tract infection, CNS disorder (Stroke, haemorrhage), diabetic conditions, any other endocrine problems eg hypothyroidism, and potential for drug related problems.

Simple investigations should be ordered and reviewed to assist above differential diagnosis and assist treatment (FBC U&E, blood sugar, ECG)

Specific treatment should be directed at clinical suspicions and continued supportive treatment with ventilatory and haemodynamic support,

General treatment of ICU patient with nutritional support, ulcer prophylaxis, thromboprophylaxis and sedation/analgesia with modification of doses for morbid obesity.

Additional considerations for management of morbidly obese ICU patient - special beds, hoists, difficulty with procedures, pressure area care, increased risk of complications.

% passed	40%
Highest mark	80%

Q 15

15.1 A 68-year-old male with chronic atrial fibrillation is noted to have the following coagulation profile

Parameter	Patient Value	Normal Range
PT	101* sec	12 – 14
APTT	45* sec	34 – 38
INR	8.7*	0.8 – 1.2

- a) **What is the likely diagnosis?**
Supratherapeutic warfarinisation

b) Outline your management of this patient?

If not bleeding:

Stop warfarin

Vitamin K

Consider FFP or prothrombinex if high risk of bleeding

If bleeding:

Resuscitation

Stop warfarin

Vitamin K in as low a dose as possible

FFP 10-15ml/kg or prothrombinex 20-25IU/kg

15.2 A 34-year-old woman is intubated and ventilated following a prolonged generalized tonic-clonic seizure. Initial non-contrast CT brain shows bilateral intracerebral haemorrhages. Arterial blood gases and haematology results post intubation are as follows:

Parameter	Patient value	Normal range
Arterial Blood Gas		
FiO ₂	0.5	
pH	7.15*	7.35 – 7.45
PaCO ₂	35 mmHg (4.6 kPa)	35 – 45 (4.6 – 6.0)
PaO ₂	105 mmHg (14 kPa)	
HCO ₃	12* mmol/l	22 – 26
Haematology		
Haemoglobin	78 g/l	130 – 150
WCC	14.5* x 10 ⁹ /l	4.0 – 11.0
Platelets	43* x 10 ⁹ /l	150 – 300

Blood picture: Thrombocytopenia, fragmented cells and reticulocytosis

Coagulation profile: Normal

a) List the abnormalities on the arterial blood gas and give the most likely cause in each case

Metabolic acidosis – lactic acidosis induced by prolonged seizure

Respiratory acidosis / inadequate compensation – inappropriate mechanical ventilation

Increased A-a gradient – aspiration pneumonia (neurogenic pulmonary oedema)

b) Give three possible diagnoses for her presentation based on the history and investigations

TTP

Eclampsia

HUS

Vasculitis

(Meningo-encephalitis – lower mark)

Evidence of MAHA with low platelets

% passed	91%
Highest mark	97%

PAPER 2

Q16

A 76-year-old man is admitted to the ICU following a laparotomy for faecal peritonitis. He has developed multi-organ failure over two days, requiring ventilatory and inotropic support. He is oliguric, increasingly acidotic, uraemic and has a rising serum creatinine.

a) List the likely mechanisms for this patient's renal failure

Likely mechanisms include pre-renal, renal and post-renal causes

Pre-renal:

Hypovolaemia (inadequate resuscitation)

Hypotension (inadequate perfusion pressure compared to his normal BP despite inotropes)

Impaired cardiac output (septic cardiomyopathy, myocardial ischaemia/infarction, dysrhythmias)

Renal:

Toxins (eg nephrotoxic drugs – need to specify gentamicin / NSAIDs / contrast for CT)

Microcirculatory failure (sepsis and inflammatory response) with medullary ischaemia, tubular obstruction and vasoconstriction (acute tubular necrosis)

Post-renal:

Raised intra-abdominal pressure

Unrecognised catheter problems

b) What would be your indications for renal dialysis in this man?

Uncontrolled electrolyte disturbances (hyperkalaemia, hypernatraemia)

Uncontrolled metabolic acidosis

Uraemia 30-35 mmol/l (optimal timing not known, uncontrolled studies suggest early CRRT better than late, candidate should have his/her own threshold level)

Fluid overload unresponsive to diuretics

Early intervention to minimise inflammatory response in sepsis may be considered but is unproven

c) Outline the means by which you would maximise urea clearance when using CVVHDF

Urea clearance depends on ultrafiltrate flow rate and dialysate flow rate so clearance enhanced by increasing blood flow rate and/or dialysate flow rate

Use of filters with larger membrane surface areas

Use of predilution

Changing filter if failing

Maximising time on CRRT by ensuring good vascular access, optimising filter life and limiting/rationalising time out of the ICU for imaging, surgery etc

% passed	96%
Highest mark	95%

Q17

You are asked to admit a 48-year-old woman for the management of respiratory failure, who received an allogeneic bone marrow transplant 2 weeks ago for acute myeloid leukaemia. A Chest X-Ray demonstrates a diffuse pulmonary infiltrate.

Initial observations

GCS 14

Temp 38.4 °C

PR 140 /min, BP 90/40mm Hg

RR 35, SaO₂ 88% on 10 lpm O₂.

The full blood count report from yesterday is at the bedside.

Hb	68 g/L	(135-180)
WCC	0.2 X 10 ⁹ /L	(4.0-11.0) No differential
Plt	39 X 10 ⁹ /L	(150 -400)

Comment - Occasional tear drops, Occasional elliptocytes, Occasional lymphocyte and neutrophil seen.

a) List your differential diagnosis for the respiratory failure

Infective – Severe sepsis in a patient with pancytopenia and agranulocytosis
Nosocomial pneumonia

- Bacterial –Gm negative –e.coli, **Pseudomonas**, Klebsiella,
- Gm positive –Strep, Staph epi
- Fungal -Aspergillus, Candida, Cryptococcus
- Atypical – Legionella, mycoplasma
- Viral –CMV, HSV, RSV, Influenza, H1N1, VZV
- PCP, toxoplasmosis
- TB (depending on background)

Sepsis due to other site and ARDS

Non- infective

- Idiopathic pneumonia syndrome
- Cardiac failure (cardiotoxicity due to induction chemo)
- Diffuse alveolar haemorrhage
- GVH – too early unless this is second graft
- Non cardiogenic capillary leak syndrome
- Chemo induced ALI / pneumonitis (methotrexate)
- TRALI
- Fluid overload

b) List your immediate management priorities (i.e. within the first two hours) of the patient on admission to ICU

Hypoxic respiratory failure

Non-invasive respiratory support commencing with CPAP progressing to BiPAP / invasive ventilation as indicated

Circulatory support

Judicious fluid resuscitation +/- inotropes to restore circulation

Central access with platelet cover

Severe sepsis

Early commencement of broad-spectrum antibiotic cover or, if already on antibiotics, review existing microbiology results, antibiotic duration and broaden or target antibiotic cover and add antifungal therapy

Review and consider removal of existing indwelling vascular devices

Pancytopenia with agranulocytosis

Reverse barrier nursing in single room

Transfusion of blood products

Investigations

CXR, ABG, Biochemistry, FBC, coagulation profile, blood cultures, sputum, urine MC&S, viral serology, echo

Discussions re prognosis

Liaison with treating haematologist to ascertain likely outcome from primary disease and BMT and also discuss with patient and family high risk of deterioration and mortality

% passed	38%
Highest mark	74%

Q18

A 50-year-old man presents to hospital with fever and an acute abdomen. He undergoes an emergency laparotomy, the findings of which include perforated carcinoma in the splenic flexure and generalized faecal soiling of the peritoneum. He undergoes a left hemicolectomy with a defunctioning colostomy. Post-operatively he is transferred to the intensive care unit because of septic shock.

a) What antibiotic regimen will you consider and why?

Triple therapy or Timentin or Tazocin – cover enterococcus, gram negatives and anaerobes. May consider adding empiric fluconazole.

Vancomycin, gentamicin, metronidazole if penicillin allergic

Despite a five-day course of antibiotics he remains unwell with fever up to 38.5°C, WCC 16.7 x 10⁹/l. He is unable to tolerate oral feeds and is on TPN.

b) List the likely abdominal causes of persistent fever and leukocytosis?

Intra-abdominal collection

Wound infection

Acalculous cholecystitis

Pancreatitis

Stomal necrosis

Blood cultures show Candida glabrata in one of the three bottles.

c) **List 4 predisposing factors for this infection in this patient.**

Malignancy
Abdominal soiling
TPN
Recent broad spectrum antibiotic therapy
Indwelling CVC

d) **What antibiotic therapy will you commence whilst waiting for sensitivities and why?**

Voriconazole or amphotericin B or caspafungin
Candida glabrata may not be sensitive to fluconazole

e) **Based on the culture report, give one other investigation, the results of which might influence the prognosis and duration of antifungal treatment, and the rationale for your choice.**

Echocardiography – vegetations
CT / USS abdomen – liver abscess
Ophthalmic examination – retinal abscesses

% passed	87%
Highest mark	87%

Q19

Critically evaluate the role of fluid resuscitation in critically ill patients with sepsis.

- 1) Hypotension a feature of sepsis
- 2) Hypotension –multifactorial – leaky capillaries, vasoplegia, myocardial dysfunction, NO, adrenergic failure
- 3) Fluid resuscitation can only treat one component of sepsis.
- 4) Current guidelines for the acute management of severe sepsis in pediatric and adult patients place prime importance on early, rapid, and substantial infusion of intravenous fluids. The immediate aim is to correct a possible fluid responsive hypodynamic circulation. Beyond this, the common assumption is that expansion of effective circulating volume will attenuate hypotension, distress) and clinical evidence of impaired peripheral perfusion.
- 5) Evidence that +ve fluid balance associated with worse outcomes in sepsis (SOAP study) and ALI
- 6) FEAST study – first RCT- compared albumin, saline and no fluid resus – Mortality at 48 hrs clearly higher in the fluid resuscitation groups.
Caveats – paediatric study, 48 hr end point, no ICU package.
- 7) In adults – a post hoc analysis of the SAFE study showed that administration of albumin as compared to saline reduced the risk of death in severe sepsis.

- 8) Other points to mention are – fluid should include blood products to a target Hb and conservative rather than liberal approach in presence of ALI. End points of fluid resuscitation are difficult

Summary statement: Fluid resuscitation is clearly indicated to treat acute hypotensive episodes. Beyond that, an assessment of causes of ongoing hypotension in sepsis must be evaluated for and treated. Robust RCTs in adults are lacking but use of albumin is preferred to saline

% passed	29%
Highest mark	80%

Q20

A 58-year-old man returns from theatre following an emergency splenectomy after a motorcycle accident. A secondary trauma survey reveals that he has suffered left sided rib fractures and a right compound tibial fracture. On admission to the intensive care unit, he is sedated, intubated and ventilated, hypotensive (80/40 mmHg), has a tachycardia (140 beats per minute) and is cool peripherally.

- a) List the likely causes of this man's shock state.**

Hypovolaemia

Ongoing blood loss related to trauma including missed injuries

Ongoing blood loss related to the emergency splenectomy

Under-resuscitation prior to ICU admission

Cardiogenic causes

Cardiac contusion

Myocardial ischaemia with pre-existing heart disease

Primary arrhythmia unlikely cause as rate only 140

Obstructive causes

Cardiac tamponade

Tension pneumothorax

Fat embolism syndrome (less likely with compound tibial fracture)

PE (less likely in acute stage)

Distributive shock states (sepsis, spinal) and anaphylaxis unlikely with cold peripheries

- b) List the clinical features that would help distinguish between these likely causes**

Hypovolaemia (ongoing bleeding / under-resuscitation)

Jugular venous pressure not visible

Positive response to passive leg raise

Cardiac tamponade

Evidence of pulsus paradoxus upon auscultation in determining blood pressure

Raised jugular venous pressure upon inspiration (Kussmaul's sign)

Muffled heart sounds

Cardiac contusion

Evidence of heart failure (raised jugular venous pressure, fine inspiratory crackles)

Tension pneumothorax

Surgical emphysema

Tracheal deviation away from side of pneumothorax

Quiet breath sounds on side of side of pneumothorax

c) What echocardiographic features are associated with the causes you have described?

Hypovolaemia

Reduced left ventricle end diastolic area

LV end systolic cavity obliteration

Reduced inferior vena cava diameter with pulse variation

Cardiac tamponade

Right atrial systolic collapse and right ventricular diastolic collapse

Increased pericardial fluid

Swinging heart

Dilated IVC

Cardiac contusion

Regional wall motion abnormalities

Tension pneumothorax

Reduced left ventricle end diastolic area

Distended superior vena cavae

% passed	60%
Highest mark	82%

Q21

A 35-year-old woman (gravida 2, para 1), 34 weeks pregnant, has been admitted to your ICU with pre-eclampsia. Her blood pressure is 160/100, she has moderate proteinuria, normal liver function and a platelet count of $120 \times 10^9/L$. There is no evidence of foetal distress. Her significant past history includes a Factor V Leiden mutation and a history of proximal vein thrombosis during her first pregnancy.

a) What pharmacological regimen would you recommend for DVT prophylaxis? Briefly outline your rationale.

Subcutaneous heparin – unfractionated previously standard of care but recommendation now for low molecular weight heparins eg enoxaparin or dalteparin:

Weight based dosing without the need for monitoring

?Reduced risk of bleeding compared to UF heparin

Reduced risk of HITS

Reduced risk of heparin induced osteoporotic fractures

PROTECT study concluded that in critically ill patients dalteparin was not superior to UF heparin in decreasing incidence of proximal vein thrombosis but proportion of patients with PE and incidence of HITS was lower in dalteparin group.

Heparin does not cross placenta unlike warfarin so no risk of foetal haemorrhage.

b) List three other inherited thrombophilias that may predispose to DVT in pregnancy?

- Prothrombin gene mutation
- Antithrombin deficiency
- Protein S deficiency
- Protein C deficiency

c) Despite appropriate DVT prophylaxis this patient develops clinical features suggestive of a proximal vein DVT. What investigations would you do to help establish the diagnosis and why?

Compression ultrasonography (sensitivity 97% and specificity 94%). Non-invasive, safe and test of choice in pregnancy.

D-dimer – levels increase with progression of normal pregnancy so need to interpret in combination with other tests.

Negative test has predictive value of 100%. Positive test has sensitivity of 100% and specificity of 60%.

If iliac vein thrombosis suspected, consider:

MRI – good specificity and sensitivity and no harm to foetus

Pulsed Doppler study

CT scan of iliac veins – NB radiation exposure to foetus

% passed	58%
Highest mark	87%

Q22

22.1 A 20-year-old female mechanically ventilated, paralysed and sedated in ICU following a diffuse axonal head injury, develops a severe exacerbation of intracranial hypertension on day 3. Investigations taken during a subsequent episode of polyuria are as follows:

Parameter	Patient Value	Normal Range
pH	7.5*	7.35 – 7.45
PaCO ₂	28* mmHg (3.7 kPa)	35 – 45 (4.6 – 6.0)
HCO ₃	21* mmol/l	22 – 27
Standard base excess	-1.5 mmol/l	-2 – +2
Sodium	147 mmol/l	135 – 145
Potassium	3.2 mmol/l	3.2 – 4.5
Chloride	110 mmol/l	100 – 110
Urea	3.0 mmol/l	3.0 – 8.0
Creatinine	65 µmol/l	50 – 100
Glucose	4.0 mmol/l	3.0 – 6.0
Measured plasma osmolality	333* mOsm/kg	275 – 295 mOsm/kg
Urine osmolality	410 mmol/l	300 – 1300 mOsm/kg

a) What is the most likely explanation for the polyuria?

Mannitol therapy

b) Give your reasoning.

Increased measured plasma osmolality with an elevated osmolar gap - 32 mOsm/kg with formula (2xNa + glucose + urea) or 44 mOsm/kg with 1.86 x (Na+K) + urea + glucose. High urinary osmolality rules out diabetes insipidus. History supports osmotherapy to treat episode of raised ICP

22.2 A 63-year-old female presented with high fever and abdominal pain. She has gram-negative bacteraemia and septic shock. The following data are from an arterial blood gas analysis:

Parameter	Patient Value	Normal Range
FiO ₂	0.3	
pH	7.43	7.35 – 7.45
PaCO ₂	23* mmHg (3.0 kPa)	35 – 45 (4.6 – 6.0)
PaO ₂	107 mmHg (14 kPa)	
HCO ₃	15* mmol/l	22 – 26
Standard base excess	-8.6* mmol/l	-2 – +2
Sodium	147* mmol/l	135 – 145
Potassium	6.7* mmol/l	3.2 – 4.5
Chloride	95* mmol/l	100 – 110
Lactate	23.0* mmol/l	< 2

a) Describe the abnormalities on the above arterial blood gas profile

Raised A-a DO₂ (78)
 High anion gap (37) metabolic acidosis with markedly raised lactate
 Metabolic alkalosis (delta ratio > 3)
 Respiratory alkalosis (PCO₂ lower than expected for HCO₃)

b) List three causes of a raised lactate in sepsis

Tissue hypoperfusion and hypoxia
 Use of adrenaline (increased glycolytic flux)
 Down regulation of pyruvate dehydrogenase by inflammatory mediators
 Underlying ischaemic tissue

22.3 A 45-year-old man is admitted unconscious to the Emergency Department. His electrolytes are as follows:

Parameter	Patient Value	Normal Range
Sodium	119* mmol/l	135 – 145
Potassium	5.5* mmol/l	3.2 – 4.5
Chloride	80* mmol/l	100 – 110
Bicarbonate	<5* mmol/l	22 - 27
Urea	10* mmol/l	3.0 – 8.0
Creatinine	105 μmol/l	50 – 100
Glucose	13.0* mmol/l	3.0 – 6.0
Lactate	8.8* mmol/l	<2
Measured osmolality	340* mOsm/kg	275 – 295
Urine ketones	Negative	

a) What are the abnormalities?

Metabolic acidosis with increased anion gap (34 mmol)
Increased osmolar gap (approx 85 mmol)
Hyperosmolar hyponatraemia
Hyperlactataemia
Mild hyperglycaemia

b) Give a possible diagnosis

Toxic alcohol ingestion (eg methanol, ethylene glycol)
Alcoholic ketoacidosis
Formaldehyde ingestion
DKA possible but osmolar gap in this case higher than expected for DKA

c) What further tests would you consider to elucidate the cause of the acid base disturbance?

Specific assays for methanol, ethylene glycol, alcohol
Urinary calcium oxalate crystals (ethylene glycol)
Formate level (metabolite of methanol)

% passed	100%
Highest mark	96%

Q23

In the context of statistical analysis of randomised controlled trials, explain the following terms:

- a) Risk ratio**
- b) Number needed to treat**
- c) P-value**
- d) Confidence intervals**

a) Risk ratio

A risk ratio is simply a ratio of risk, for example, [risk of mortality in the intervention group] / [risk of mortality in the control group].
It indicates the relative likelihood of experiencing the outcome if the patient received the intervention compared with the outcome if they received the control therapy.

b) Odds ratio

Odds ratio is the odds of an event occurring in one group to the odds of it occurring in another

c) Number needed to treat (NNT)

Number of patients that need to be treated for one patient to benefit compared with a control not receiving the treatment

$1/(\text{Absolute Risk Reduction})$

Used to measure the effectiveness of a health-care intervention, the higher the NNT the less effective the treatment

d) P-value

A p-value indicates the probability that the observed result or something more extreme occurred by chance. It might be referred to as the probability that the null hypothesis has been rejected when it is true.

e) Confidence intervals

The confidence intervals indicate the level of certainty that the true value for the parameter of interest lies between the reported limits.

For example:

The 95% confidence intervals for a value indicate a range where, with repeated sampling and analysis, these intervals would include the true value 95% of the time

% passed	71%
Highest mark	97%

Q24

Outline the important management principles in treating a patient who has been admitted to your ICU intubated and ventilated immediately following successful resuscitation from an out of hospital cardiac arrest.

Post-resuscitation care has an impact on overall outcome and consists of ongoing resuscitation and organ support, neuroprotection, treatment of the cause of the cardiac arrest and management of underlying co-morbidities

Check adequacy of airway, ETT position, ventilation and circulatory status
Appropriate monitoring and intravenous access

Ventilation: Control CO₂
Avoid hypoxia and hyperoxia

Circulation: Stabilise circulation with fluid therapy and vasoactive drugs
Consider early echo
Diagnosis / treatment of acute coronary syndrome with angiography/PTCA or thrombolysis
Evaluation for pacemaker or ICD if primary dysrhythmia
Mechanical support - use of IABP for cardiogenic shock in acute MI has recently been questioned. Some centres may consider use of ECMO

Neurological: Therapeutic hypothermia at 32-34°C for 12-24 hr appears to be neuroprotective with improved neurological outcome although the optimal method and timing of cooling is still to be determined
Treatment of seizures

Diagnosis and management of precipitating event

% passed	82%
Highest mark	90%

Q25

With respect to malaria:

a) Describe the laboratory confirmation of this condition

Thick and thin blood smears (give diagnosis and parasite load)

Rapid diagnostic tests utilising malarial antigens (dependents on specific test)

b) List 2 firstline drugs from different classes given parenterally in the treatment of the severe form of this disease

Cinchona alkaloids (quinine and quinidine)

Artemisinin derivatives (artesunate, artemether).

c) List the acute complications of this disease

- Cerebral Involvement with or without convulsions
- Respiratory Failure - acute respiratory distress syndrome (ARDS)
- Circulatory collapse
- Renal failure, hemoglobinuria ("black water fever")
- Hepatic failure
- Haematological
 - Disseminated intravascular coagulation
 - Severe anemia secondary to Haemaolysis
 - Thrombocytopenia
- Metabolic
 - Hypoglycemia
 - Severe Acidosis
 - Hyponatraemia
- Splenic Rupture

% passed	82%
Highest mark	92%

Q26

26.1. List 4 clinical signs which may be noticeable on examination of the head in a patient with cerebellar disease

Nystagmus

Titubation

Staccato speech

Skew deviation of the eyes

Impairment of finger-nose test

26.2. A patient presented with sudden onset of weakness involving his left upper and lower limb. On examination, he was conscious, with a dilated non-reactive right pupil, normal power in the right upper and lower limbs, and a left hemiparesis.

What is the likely site of lesion? Outline your reasoning.

Right side of the midbrain. It is a crossed hemiplegia suggesting a brainstem stroke and the 3rd nerve nucleus is located in the midbrain.

26.3. List 4 causes of a diastolic murmur over the apical area

Mitral stenosis
Severe mitral regurgitation (flow murmur)
Significant left to right shunt (VSD)
Austin-Flint murmur of aortic regurgitation
Carey-Coombs murmur

26.4. On examination of a critically ill patient who was in respiratory distress, the following signs were noted:

Tachypnoea

SpO2 88%

Trachea shifted to the left

Reduced air entry and dullness to percussion in the infraclavicular and axillary areas on the left side.

a) What is the likely lung pathology?

Left lung collapse

b) List 3 causes of this pathology in critically ill patients.

Right bronchial intubation
Mucus plugging – left main bronchus
Obstructive lesions left main bronchus.

% passed	84%
Highest mark	97%

Q27

27.1. List the features of the device depicted below

A picture of a heat & moisture exchange filter was given

Hydrophobic pleated filter for heat and moisture exchange
Bacterial and viral filtration properties
Filter protects against liquid and airborne contamination
Minimal resistance to airflow
Luer lock gas sampling port (connects to ETCO₂ monitoring)
15mm/22mm ISO standard connectors
Disposable single patient use

27.2.

- a) What is the device depicted below?**
- b) List the indications for its use in the ICU**

A picture of a right-sided double lumen endobronchial tube was given

Double lumen endobronchial tube (right sided)

Anatomical or physiological lung separation

Massive haemoptysis from unilateral lesion

Whole lung lavage eg alveolar proteinosis

Copious infected secretions with risk of soiling unaffected lung eg bronchiectasis, lung abscess

Unilateral parenchymal injury

Aspiration

Pulmonary contusion

Pneumonia

Unilateral pulmonary oedema

Single lung transplant

Bronchopleural fistula

Unilateral bronchospasm

27.3.

- a) What is the device depicted below?**
- b) List the contra-indications to its use**

A picture of a Passy Muir speaking valve was given

Passy Muir speaking valve

Unconscious / comatose patient

Inflated tracheostomy tube cuff

Severe upper airway obstruction that may prevent sufficient exhalation

Excessive secretions

Severe COPD with gas trapping

Foam filled cuff tracheostomy tube (eg Bivona)

Endotracheal tube

% passed	38%
Highest mark	70%

Q28

A 27-year-old male presents with a severe head injury (GCS 4 at the scene), sustained in a high-speed motor vehicle collision. His initial CT scan in the emergency department shows a 2x3x2.5cm frontal haemorrhagic contusion and diffuse oedema. He is taken directly to the operating theatre where an external ventricular drain (EVD) is inserted. The patient is settled into the ICU and his secondary survey does not reveal any other significant injuries. The initial ICP is 32 mmHg after the EVD is connected.

a) If the ICP is refractory to your initial management of sedation, paralysis and correct positioning, what further measures will you consider and why?

- Ensure EVD patent and CSF draining (reduce CSF component of ICP)
- Measures to maintain CPP > 60 mmHg
 - Fluids (avoid albumin – SAFE TBI)
 - Vasopressors
- Repeat CT scan to exclude a new mass lesion
- Osmotherapy (hypertonic saline or mannitol)
 - Goal Na⁺ 150, Osm 300-320
- Consider barbiturates or propofol (decrease CMRO₂)
- Consider continuous paralysis (decrease CMRO₂)
- Consider moderate hypothermia (decrease CMRO₂ and potentially neuroprotective)
 - Adverse outcome in paediatric TBI RCT from CCCTG
 - McIntyre MA suggesting titrated to ICP and prolonged duration may be beneficial
 - Ongoing trials including POLAR in ANZ
- Decompressive craniotomy is contentious
 - DECRA showed decreased ICP and reduced ICU length of stay but no mortality benefit and a greater number of patients with an unfavourable neurological outcome in those who received decompressive craniectomy.
 - Patients with mass lesions (unless too small to require surgery) were excluded so this patient may not have been included in the study
 - Only a single surgical intervention was used

b) What are the risk factors for post-traumatic seizures in patients with traumatic brain injury?

- GCS < 10
- Cortical contusion
- Depressed skull fracture
- Subdural, epidural or intracerebral haematoma
- Penetrating head wound
- Seizure within 24 hours of injury

% passed	34%
Highest mark	70%

Q29

29.1. A 24-year-old woman has the following haematology and coagulation profile post admission to the intensive care unit following post partum haemorrhage

Parameter	Patient Value	Normal Range
White cell count	$5.6 \times 10^9/l$	4.0 – 11.0
Haemoglobin	60 g/l	115 – 165
Platelets	$30 \times 10^9/l$	150 – 400
PT	30.6 sec	10.5 – 13.5
APTT	>150 sec	21 – 36
D-dimer	>10 $\mu\text{gm/ml}$ FEU	<0.4
Fibrinogen	0.8 g/l	1.1 – 3.2

a) What does this pattern of coagulation abnormalities suggest

DIC

b) List three likely causes of this coagulation profile in this patient

Pre-eclampsia
 Amniotic fluid embolism
 Sepsis
 Intra-uterine fetal death
 Mismatched / massive transfusion

c) What does an elevated D-dimer indicate?

Tests fibrinolysis. Measures the break down of the cross-linked fibrin

29.2. These are the biochemical results taken from a 48-year-old man, missing from an alcohol rehabilitation program and found in his home comatose by police three days from the time he was last seen.

Parameter	Patient Value	Normal Range
Sodium	126* mmol/l	138 – 145
Potassium	3.5 mmol/l	3.5 – 5.2
Creatinine	250* $\mu\text{mol/l}$	40 – 100
Urea	7.0 mmol/l	3.1 – 7.5
Bilirubin (total)	509* $\mu\text{mol/l}$	2 – 22
Protein (total)	40* g/l	65 – 85
Albumin	20* g/l	38 – 48
ALP	153* IU/l	40 – 100
GGT	459* IU/l	0 – 50
ALT	336* IU/l	0 – 45
CK	400* IU/l	30 – 180
Troponin	0.1 $\mu\text{g/l}$	0 – 0.3
Glucose	3.2* mmol/l	3.5 – 4.6
Ammonia	342* $\mu\text{mol/l}$	0 – 50
Lactate	3.7* mmol/l	0.6 – 2.4

a) Given this presentation, list 3 possible causes of his altered conscious state?

Alcohol intoxication
Hepatic encephalopathy
Drug ingestion
GI bleed
Sepsis
Intracranial bleed

b) Interpret the biochemical abnormalities

Liver dysfunction as demonstrated by elevated enzymes, reduced albumin, hypoglycaemia with decompensation indicated by marked elevation of ammonia. Hyponatraemia in keeping with cirrhosis. Raised lactate as a result of liver dysfunction / alcoholic ketoacidosis / sepsis / thiamine deficiency
Raised creatinine indicates renal dysfunction and urea may be apparently "normal" because of decreased hepatic dysfunction and possible nutritional deficiencies. Urea:creatinine ratio suggests that GI bleed and/or dehydration are unlikely

% passed	84%
Highest mark	87%

Q30

30.1. Examine the clinical photograph below (image removed)

a) What clinical sign is illustrated here?

Raccoon or Panda eyes

b) What does this indicate?

Frontal base of skull fracture

c) List 2 other clinical signs which may be present which might support your answer in b?

Haemotympanum
CSF rhinorrhoea or otorrhoea.

30.2. This patient presented is admitted to your ICU with respiratory failure following a motor vehicle accident. The following clinical sign (see picture below) were present on examination of the patient.

(image removed)

a) What clinical sign is illustrated in this picture?

Conjunctival petechiae

b) What is the likely cause of the respiratory failure?

Fat embolism syndrome

% passed	93%
Highest mark	90%

HOT CASES

Prince of Wales Hospital

1. 79-year-old female, 5 days post laparotomy for small bowel obstruction with division of adhesions and small bowel resection. Background AF and hypothyroidism. Slow to wake and wean from invasive respiratory support. GIT failure with intolerance of enteral feeds, on TPN and new onset abdominal wound discharge.
Candidates were directed to examine the patient with respect to assessment of nutritional status and fluid balance and failure to establish enteral feeds
2. 69-year-old male admitted the previous day with community-acquired pneumonia and septic shock requiring non-invasive ventilation and low dose vasopressors.
Candidates were directed to review the patient's respiratory status and formulate a plan for ongoing management
3. 75-year-old male, ICU day 12 with community-acquired pneumonia, septic shock and multi-organ failure, on CPAP/PS via oral ETT, anuric on CRRT and requiring low dose vasopressor support.
Candidates were directed to assess the patient with a view to planning for weaning from ventilatory support
4. 85-year-old female day 3 post elective AVR and CABG complicated by bleeding, vasoplegic shock and pulmonary hypertension. Candidates were asked to identify the current issues and formulate a management plan

Royal Prince Alfred Hospital

1. 22-year-old male, day 12 with severe traumatic brain injury. Urgent right lateral craniectomy, posterior fossa decompression and evacuation of SDH on admission. GCS 4 off sedation. New onset fever. Candidates were asked about assessment and management of fever and weaning plan
2. 30-year-old female, day 3 ICU with a diagnosis of TTP who presented with fever, headaches, vomiting for one day and decreased conscious state. Candidates were asked to examine the patient to determine the differential diagnosis
3. 69-year-old male with prolonged admission to ICU for septic shock for E coli liver abscess. Failed ward discharge and re-admitted with new fever. Findings include cachexia and generalized weakness, signs of COPD, tracheostomy, delirium, right chest drain for pleural effusion, abdominal drain with old drain sites.
Candidates were directed to examine the patient with a view to making a differential diagnosis for the cause of the new fever
4. 83-year-old female day 11 ICU with ARDS post TKR. Slow progress with encephalopathy and weakness.
Candidates were directed to assess the patient with a view to discussing prognosis
5. 70-year-old male admitted with multi-organ failure and intra-abdominal sepsis secondary to perforated duodenum post lap cholecystectomy. Candidates were directed to assess the patient with a view to determining the current problems and making a management plan for the next 24-48 hr.
Discussion points included intra-abdominal sepsis, antibiotic choice, use of vasopressors, anticoagulation for CRRT, nutrition plan and CXR and ABG

6. 70-year-old IVDU admitted with respiratory failure. On examination severely deconditioned and wasted, awake and responsive, ventilated with low FiO₂, CXR showing 3/4 quadrant involvement with interstitial infiltrate.
Candidates were directed to assess the patient with a view to identify current problems and how to progress patient management
7. 55-year-old male admitted with septic shock secondary to right lower lobe pneumonia.
Candidates directed to determine cause of septic shock

Royal North Shore Hospital

1. 20-year-old male with severe traumatic brain injury secondary to fall from skateboard, decompressive craniotomy, intracranial hypertension, aspiration pneumonitis with lower zone collapse/consolidation, ventilated with NO
2. 79-year-old male 3 days post CABG, failed extubation for respiratory failure, AF treated with amiodarone and cardioversion, acute on chronic renal impairment.
3. 78-year-old female post emergency CABG for NSTEMI with ongoing inotropic support, right frontal subacute infarct with left hemiplegia, fluid overload, slow wean from ventilatory support.
4. 52-year-old female day 17 ICU with 45% burns requiring debridement and grafting
5. 55-year-old male day 3 ICU, known epileptic, with 35% burns from hot water following a seizure in the shower. Awaiting C-spine clearance, hypotensive on inotropes, febrile, signs of underlying COPD.
6. 18-year-old male with 10% burns to face and hands, intubated for airway oedema, febrile with likely ventilator associated pneumonia, weaning sedation
7. 77-year-old male with meningitis and also head injury following fall, recent NSTEMI, pneumonia, liver lesions under investigation and chronic leukaemia.
8. 48-year-old man with multi-trauma following motorbike crash with chest and intra-abdominal injuries
9. 64-year-old male day 5 ICU following out of hospital VF arrest, revascularised, treated with hypothermia.

St George's Hospital

1. 23-year-old male with multi-trauma including traumatic brain injury with refractory intracranial hypertension despite decompressive craniotomy, sedation, paralysis and hypothermia. Candidates were asked to assess the patient and discuss management of intracranial hypertension
2. 33-year-old male post abdominal surgery for mesothelioma complicated by bleeding and intracranial hypertension requiring a repeat laparotomy. Candidates were asked to assess him for suitability for extubation.
3. 71-year-old female with multi-trauma following pedestrian versus car. Candidates were directed to assess patient and make a management plan
4. 62-year-old male post re-do CABG with persisting low cardiac output state on IABP with background ESRF on peritoneal dialysis. Candidates asked to assess patient and make a management plan

VIVAS

Viva 1

A 69-year-old man has been ventilated for an infective exacerbation of chronic obstructive pulmonary disease (COPD). His ICU course has been complicated by septic shock and acute kidney injury that required renal replacement therapy. His therapy has included steroids and an aminoglycoside in addition to other standard care for his COPD.

12 days later neurological examination off sedation reveals spontaneous eye opening, obeying of commands, and normal cranial nerves. Motor examination of the limbs reveals symmetric reduction in tone and tendon reflexes with moderate to severe weakness. Plantar responses are equivocal. Sensory examination is normal. Examination of the chest and recent CXR are both unremarkable. He remains intubated with a spontaneous mode of ventilation (Pressure Support of 15, PEEP 7, FiO₂ 0.35). Attempts to wean pressure support have been poorly tolerated. Other vital signs and organ function remain stable.

1. List the differential diagnoses for his weakness and explain your reasoning.

The rest of the viva focussed on the diagnosis and management of critical illness neuromyopathy

Viva 2

*In this viva, the focus of the question will be on Evidence Based Medicine
Please read this modified abstract of a study recently published in the New England Journal of Medicine*

Decompressive Craniectomy in Diffuse Traumatic Brain Injury

Background

It is unclear whether decompressive craniectomy improves the functional outcome in patients with severe traumatic brain injury and refractory raised intracranial pressure.

Methods

Of 3478 patients screened, we randomly assigned 155 adults with severe diffuse traumatic brain injury and intracranial hypertension that was refractory to first-tier therapies to undergo either decompressive craniectomy or standard care. Intracranial hypertension was defined in the study as an increase in intracranial pressure above 20 mm Hg for more than 15 minutes. Patients with intracranial mass lesions were excluded from the study.

Results

Patients in the craniectomy group had less time with intracranial pressures above the treatment threshold ($P < 0.001$), fewer interventions for increased intracranial pressure ($P < 0.02$), and fewer days in the intensive care unit ($P < 0.001$). However, patients undergoing craniectomy had worse scores on the Extended Glasgow Outcome Scale than those receiving standard care (odds ratio for a worse score in the craniectomy group, 1.84; 95% confidence interval [CI], 1.05 to 3.24; $P = 0.03$) and a greater risk of an unfavourable outcome (odds ratio, 2.21; 95% CI, 1.14 to 4.26; $P = 0.02$). Rates of death at 6 months were similar in both groups.

Conclusions

In adults with severe diffuse traumatic brain injury and refractory intracranial hypertension, early decompressive craniectomy decreased intracranial pressure and the length of stay in the ICU but was associated with more unfavourable outcomes.

1. A colleague says this study shows that decompressive craniectomy should be abandoned for traumatic brain injury. Do you agree?

The rest of the viva focussed on EBM and critical appraisal of the literature

Viva 3

You are asked to review an 88-year-old man who has fallen from a ladder. He is in the ED with a large subdural haematoma (SDH) and significant mid-line shift. His GCS is 6/15. He has a past medical history that includes ischaemic heart disease (CABG in 2008), chronic airflow limitation (inhaled bronchodilators and oral steroids), atrial fibrillation (warfarin and digoxin), chronic renal impairment (creatinine 190 $\mu\text{mol/L}$), non-insulin-dependent diabetes and mild memory impairment.

1. What are the factors in this patient's story that suggest his outcome might be poor?

The rest of the viva focussed on severity scoring and the management of the elderly critically ill patient

Viva 4

A 65-year-old man with chronic obstructive pulmonary disease (COPD) and known chronic alcoholic liver disease has been in the ICU for 48 hrs with septic shock, due to an infective exacerbation of COPD. He has been treated with antibiotics, fluid therapy, initial catecholamine support for hypotension that has now been weaned off, mild renal impairment that did not require dialysis, and intermittent non-invasive ventilation. You are called by your registrar at 1am because the patient has just vomited 250ml of 'coffee-ground vomit'

1. What is your approach to this problem, and what advice will you give the registrar?

The rest of the viva focussed on the management of upper GI bleeding

Viva 5

A 45-year-old woman has been referred to the High Dependency Unit from the Emergency department for haemodynamic monitoring following an episode of hypotension, which has responded to 3L fluid resuscitation.

She had presented with one day of worsening malaise and myalgia on a background of having just completed a six week course of intravenous flucloxacillin for osteomyelitis of her left foot administered through a peripherally inserted central line (PICC). Examination in the emergency department revealed that she was febrile (38.5°C), tachycardiac (120 bpm) and hypotensive (90/60mmHg) but otherwise was unremarkable. The PICC is still in situ.

Initial investigations:

		Normal Range
Hb	130 g/L	115-160
WCC	24 x10 ⁹ /L	4.0-11.0
Neut	20 x10 ⁹ /L	1.8-7.5
Plat	200 x10 ⁹ /L	150-400
Urea	6.4 mmol/L	2.5-7.5
Creatinine	72 µmol/L	40-90
CRP	230 mg/L	<10
Urinalysis	No abnormality detected	
Chest X-Ray	Clear	

The admitting team commences daily intravenous ceftriaxone 1gm and azithromycin 500mg with a provisional diagnosis of sepsis of unknown origin.

1. Please comment on the antibiotics chosen and justifications for your comments.

The rest of the viva focussed on antimicrobial prescribing.

Viva 6

Radiology station.

Candidates were asked to comment on chest X-rays, head and abdominal CT scans

Viva 7

You are asked to speak to the parent of a 21-year-old male, Kevin Smith, who was readmitted to your ICU last night. He was originally admitted to your ICU with a severe traumatic brain injury 4 months ago. He had aggressive treatment including a decompressive craniectomy. He was discharged from your ICU with severe neurological deficits.

He has been on a rehabilitation ward for the last 2 months, making a slow recovery. His treating team believe that he still has the potential to make a reasonable neurological recovery, although he currently remains severely neurologically impaired. He was readmitted to ICU last night with pneumonia requiring invasive mechanical ventilation.

The nursing staff informs you that his parent wants to speak to you.

Viva 8

You are called to review a 56 yr old 120 kg lady who has been admitted with a community acquired pneumonia . She is on 50% O₂ ,on a CPAP of 10cm H₂O with an SaO₂ of 90% and has a respiratory rate of 35bpm. You have decided to intubate and ventilate this lady.

1. Please list the equipment that you require to assist you in this intubation.

The rest of the viva focused on airway management.